



A.D. 1857 N° 1045.

S P E C I F I C A T I O N

OF

CHARLES BARLOW.

FURNACES.

L O N D O N :

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Furnaces.

LETTERS PATENT to Charles Barlow, of the Office for Patents, 89, Chancery Lane, London, for the Invention of “**CONSUMING THE SMOKE AND GASES OF FURNACES, AND AT THE SAME TIME FURNISHING A HOT-AIR BLAST, BEING A SMOKE AND GAS-CONSUMING HOT-AIR BLAST FURNACE.**”—A communication from Thomas Aldridge, of the City of Hudson, Jersey, United States.

Sealed the 13th October 1857, and dated the 13th April 1857.

PROVISIONAL SPECIFICATION left by the said Charles Barlow at the Office of the Commissioners of Patents, with his Petition, on the 13th April 1857.

I, CHARLES BARLOW, of the Office for Patents, 89, Chancery Lane, London,
5 do hereby declare the nature of the said Invention for “**CONSUMING THE SMOKE & GASES OF FURNACES, AND AT THE SAME TIME FURNISHING A HOT-AIR BLAST, BEING A SMOKE AND GAS-CONSUMING HOT-AIR BLAST FURNACE,**” a communication from Thomas Aldridge, of the City of Hudson, State of New Jersey, United States, to be as follows:—

10 It consists in the application & use of a new and improved method of transferring the smoke and gases of furnaces from the chimney or smoke stack to the furnace, and in such a manner that they will be most effectually

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and economically consumed, and in mixing therewith a continual supply of heated atmospheric air for the purpose of changing its character, so as to become a better supporter of combustion, and effecting this before the smoke & gas comes in contact with the fire, & by this whole operation securing also a constant hot-air blast for any such furnace. 5

To the chimney or smoke stack of a furnace, and upon either side as most convenient, though I deem the most preferable that side opposite or nearest opposite the furnace, and at or near the part or place where the smoke and gases enter after they pass from contact with the boilers, is attached a large pipe or conductor, the other end of which enters or opens into the front part 10 of the furnace and under the fire or grate bars, such pipe being close, and the doors into the furnace and ash-pits being also kept closed all the time. To this pipe and near the chimney is attached a blower of sufficient capacity to draw the smoke, &c. from the chimney and force it through such pipe and under the fire, and which may be driven by the engine or any convenient power. 15

I am aware that efforts have been made to consume the smoke & gases of furnaces, and that some have been partially successful, but such, so far as I can learn, attempt to confine or keep back the smoke, gas, &c., on top of the fire by inverted arches of some contrivance for the same purpose, where it shall be retained and burned; whereas my Inventions takes all these from the 20 chimney and carries them to and feeds them under the fire, through which they naturally ascend, and by which they are consumed. In order to keep up a supply of oxygen for the purpose of increasing heat and combustion, there is a tube or pipe, one end of which is open to the atmosphere, and which passes by or near the boiler, so that the air in it will be completely heated, and the 25 other end of which enters the smoke conductor between the chimney and the blower, so that the draft of the blower shall cause a constant renewal of such atmospheric air. As it is known, the principal gas evolved from the consumption of coal is carbonic acid gas, which is by itself not a supporter of combustion; by mixing, however, with this gas atmospheric air, the nitrogen 30 of the atmosphere unites with the carbonic acid gas and produces an inflammable gas. By causing, therefore, the atmospheric air to be mixed with the gases drawn from the chimney, and at such a point that these can be well mixed and combined before they reach the fire, we secure as supporters of combustion, in addition to the smoke, which is principally small particles of 35 coal, and besides the oxygen which is found in the atmosphere, another inflammable gas, which is made up of two gases, each of which is a non-supporter of combustion when uncombined with the other. The supply of such gas will necessarily depend somewhat upon the perfectness of mingling and

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combination. When the smoke and gases are held or kept back on top of the fire, even if atmospheric air is admitted there, the union cannot be very complete, because the natural draft alone would be unfavourable both for such combining as well as to their retention there for the purpose of being consumed. When, however, they are mixed and united, as described, before they reach the fire, the greatest possible quantity of supporters of combustion will be produced, all of which will be also, as before stated, fed under the fire, and where they will most effectually support combustion, and also render unnecessary any device for keeping them in contact with the fire. The admission of these gases under the fire gives also a like high temperature to every part of the fire and prevents the formation of clinkers, et id omne genus, as these are produced from melting and running together, all of which is prevented, the constant incoming of these gases burning the coal and not melting it. This also produces a more complete consumption of the fuel, and thus saves cost.

As will be apparent, the draft of the fire will not depend upon the form or elevation of the chimney, the expense of which may be saved, but upon the speed of the blower, & the power with which the smoke and gases are supplied to the fire. This draft, or the speed of the blower, is therefore regulated by the pressure of the steam in the boiler, the velocity and draft increasing as the pressure falls below the required standard, and vice versa, thus rendering my Invention self-adjusting or automatic, and to any pressure wished. This I accomplish by the use of two conical pulleys, one of which is worked from the engine, and the other operates the blower, these pulleys being connected by a belt. This belt is moved on these conical pulleys, and thereby the velocity of the blower increased or diminished by a strap stick, worked by a series of levers, which are moved by the raising or falling of a piston in a small cylinder, to which steam is admitted by a pipe connecting with the boiler, and the action of which piston may be regulated or graduated according to any required pressure. As the pressure increases the piston will be raised, and the belt, by means of the levers, &c., will be moved to a smaller part of the pulley worked by the engine, and to a larger part of the opposite one, thus decreasing the speed of the blower and lessening the draft; but as the pressure diminishes, a contrary movement takes place, increasing the velocity of the blower and increasing the blast or draft.

The general character of my Invention therefore consists in an improved method of consuming the smoke and gases of furnaces, by taking them from the chimney near where they enter it, thus losing but little or any, and in mixing and combining therewith heated atmospheric air, & thereby pro-

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ducing a new element, which is also a supporter of combustion, and in producing this combination and mingling before these substances come in contact with the fire, and in feeding all these under the fire, thus rendering their combustion most complete; and also effecting the same in the most economical manner, and securing the greatest amount of heat therefrom, and 5 in regulating the action of my Invention, & consequently the draft of the furnace, by the pressure of steam in the boiler decreasing the draft as the pressure becomes too great, and increasing it as the pressure falls too low, thus rendering the whole automatic and self-adjusting.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed 10 by the said Charles Barlow in the Great Seal Patent Office on the 13th October 1857.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, CHARLES BARLOW, of the Office for Patents, 89, Chancery Lane, London, send greeting. 15

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Thirteenth day of April, in the year of our Lord One thousand eight hundred and fifty-seven, in the twentieth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Charles Barlow, Her special licence that I, the said Charles Barlow, my 20 executors, administrators, and assigns, or such others as I, the said Charles Barlow, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel 25 Islands, and Isle of Man, an Invention for "**CONSUMING THE SMOKE AND GASES OF FURNACES, AND AT THE SAME TIME FURNISHING A HOT-AIR BLAST, BEING A SMOKE AND GAS-CONSUMING HOT-AIR BLAST FURNACE,**" a communication from Thomas Aldridge, of the City of Hudson, Jersey, United States, upon the condition (amongst others) that I, the said Charles Barlow, my executors or adminis- 30 trators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent. 35

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NOW KNOW YE, that I, the said Charles Barlow, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being also had to the accompanying Drawings, 5 and to the letters of reference marked thereon, and making a part of this Specification:—

The nature and object of the said Invention consists in the application and use of a new and improved arrangement and combination of mechanism, by means of which the smoke and gases that generally pass off through 10 the chimney and are lost are withdrawn from the chimney or smoke flue thoroughly mixed and incorporated with abundant supplies of highly-heated atmospheric air, so as to promote their complete combustion, and then to and forced under and through the fire or furnace, where they will be effectually consumed, thereby economising fuel and obtaining a greatly increased amount 15 of heat, and also securing a constant hot-air blast, and in rendering the whole arrangement of the mechanism self-adjusting by and according to the pressure of steam in the boiler.

Fig. 1 is a perspective view of an ordinary tubular boiler and furnace with the Invention or improved arrangement attached thereto, and shewing also the 20 manner of rendering the same self-regulating according to the pressure of steam in the boiler.

Fig. 2 is a more particular view of the mechanism by which the Invention is made self-adjusting or automatic by means of steam in the boiler and according to any desired pressure of it.

25 In the various Inventions which have been heretofore made and used to effect the combustion of the smoke and gases of furnaces, the arrangement has usually been to retain and confine these on top of the fire untill they could be consumed, thus, in fact, making the furnace a close furnace, and therefore rendering some means to facilitate combustion retarded by their continued 30 pressure on top of the fire, and the pressure of which would of course somewhat interfere with or check the natural or needed draft of the fire. In those cases in which it has been sought to carry the smoke, &c. under the fire, the action has been very imperfect, and the results generally unsatisfactory.

All such objections are obviated by this Invention, while its action is uni- 35 form and complete, effecting the entire combustion of the smoke, and at the same time increasing, and, in fact, creating the draft of the furnace, which draft is also rendered automatic or self-adjusting according to the pressure of steam, that is, the draft is increased or diminished as the pressure falls below or exceeds any given standard.

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Its construction and operation, as illustrated by the Drawings, are as follows :—When attached to a differently arranged boiler its construction will vary somewhat, but the principle of its operation will be the same. A is an ordinary cylinder boiler, set in a foundation B, and the chimney and smoke stack being at the rear end of the boiler, and in the case represented a little at one side of the boiler. D is the furnace door, and E the door to the ash-pit underneath the fire ; these are constructed in any of the ordinary ways, there being nothing peculiar in respect to them. To the chimney or smoke stack, at or near the point or level at which the smoke and waste gases of the fire enter it and cease to act upon the boiler, is connected or inserted a tube, or smoke and gas conductor F, the other end of which opens into the ash-pit or underneath the grate. In constructing new furnaces, or when it can be done in the alteration of old ones, it will be advisable to place this conductor within the foundation of the boilers and thus underneath them, and opening under the fire through the bridge wall, so that any heat which shall radiate from this conductor shall not be lost, but will act upon the boilers, and thus be effective ; or this conductor may be metallic, and may be caused to pass through the steam chamber, or a steam chamber provided for the purpose, and thus be rendered highly effective for the purpose of superheating steam ; or it may, and this will most likely be the case when the Invention is to be attached to furnaces and boilers already built and set and in use, be placed outside the work supporting the boilers, &c. It may also be made of iron, wood, or brick, but when outside should be made of materials which are the best non-conductors of heat, or protected by non-conductors. It may also be connected to either side of the chimney or smoke stack most convenient in any particular case, though generally it will be best to have the connection as high as, or, perhaps, some little above, the entrance of the direct flue into the chimney. When the boilers do not extend to the chimney or smoke stack, and a flue is used to conduct the products of combustion to the chimney or smoke stack, the conductor F should connect with such flue at or near the point where the smoke, heat, &c. cease to affect the boilers ; such conductor may of course be accommodated in shape and position to the circumstances of any particular case, but sharp angles should be avoided when possible, and care should be taken to connect it to the chimney or smoke stack or flue at or near the point or place where the smoke, gases, &c. cease to act upon and affect the boilers, and that the other end open under the furnace or grate bars.

To the conductor F is connected or attached a blower G, the exact location of which is not material, except that it is well to place it near the chimney or flue, where the conductor F connects therewith, so as to draw more com-

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pletely the smoke, gases, &c. from the chimney or flue to ensure their more perfect combustion. The construction of this blower is not material, except that the receiving orifice through which the smoke and gases are taken from the chimney or flue, and the discharge orifice through which they are driven
5 toward the fire, should be large, and as long as the fans, so that there shall be no obstruction to the free entrance and exit of these substances. The blower now used has these orifices on its opposite sides, the former being nearer the top and the latter nearer the bottom, and with other orifices on the other sides to receive atmospheric air, as hereafter mentioned. When wished, for any pur-
10 pose, the conductor F in front of the blower may be divided, and the smoke, &c. be delivered at different points under the furnace or under different furnaces. The size of the blower will also vary according to the size of the furnace, and the fuel consumed. The action of this blower is to continually draw the smoke, gases, &c. from the smoke stack or flue, and prevent any
15 escaping therefrom, and force them through the conductor F and under the fire, in passing through which every thing combustible or inflammable is consumed or rendered useful, thereby economizing fuel and increasing heat. The furnace and ash-pit doors are kept tightly closed to prevent any air entering through them.

20 In order, however, to ensure economy and effect in the combustion of fuel a large and copious supply of air is necessary, and as "perfect combustion" has been defined to be "the prevention of smoke," the supply of air necessary is such quantity as will render the products of combustion transparent or "smokeless." An insufficient supply of air causes incomplete combustion,
25 and a consequent waste of a great part of the heat evolved from or by the fuel. Such supply of air is secured by means of an atmospheric air pipe, the mouth of which is seen at H, and the other end of which enters the blower, or the conductor F between the blower and the chimney or flue. This pipe should be large enough to furnish the air requisite, and its size will be determined
30 from the quantity of gases, &c. produced from combustion, and the quantity of air according to the best authorities required for their combustion. This pipe should, however, be made amply large enough, and its mouth may be regulated by a door I. As this pipe connects with the blower, or the conductor near the blower, the action of the blower is to create and continue a constant
35 suction or draft of atmospheric air through it, and into the conductor F, as well as to draw the smoke from the chimney.

The combustion of fuel, and particularly coal, as is well known, produces large quantities of carbonic acid and carbonic oxide, the latter of which is formed by the carbonic acid passing over the intensely ignited coal of the

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furnace, a portion of which it takes up, and if the carbonic acid could be retained sufficiently long in contact with the heated coal it would be wholly converted into the oxide. Carbonic oxide is, however, unlike carbonic acid, inflammable, and in burning gives out a large amount of heat. In ordinary furnaces this gas passes off through the chimney, carrying with it a great proportion of the heat it should give out if the coal had been burned with a due supply of air. By the arrangement before described, this gas, together with the other products of combustion, is prevented from escaping. As, however, gases do not rapidly mix with each other, and as it is necessary for the purposes of combustion in a furnace that such union should be effected with great rapidity, and as the union of gases is rather mechanical than a chemical affinity, it is very desirable and necessary that the smoke and gases drawn from the chimney should be thoroughly and intimately mixed with the atmospheric air, and that such mingling should be effected before these elements are brought in contact with the fire. This desirable result is accomplished by causing the atmospheric air tube to open into the blower case, or into the conductor F between the blower and the chimney or flue, so that the smoke and gases drawn from the chimney or flue and the air shall be together subjected to the action of the blower, and thus be completely and thoroughly mixed and united, and that before they reach the furnace or fire. In order, however, that the temperature of the fire may not be reduced by the constant supply of such quantities of atmospheric air as are necessary for the consumption of the products of combustion, the atmospheric air pipe is so placed in respect to the fire or flues of the furnace, that the air passing through it will be thoroughly and highly heated before it reaches the blower or conductor, as above described. By this arrangement the introduction of the required quantity of atmospheric air is prevented from acting at all as a cold blast, but is made in reality a hot blast, and if more air happens to be admitted than is required for the perfect combustion of the gases, &c., the surplus is in effect an additional heating element, which instead of taking up the heat of the fire will impart its heat to it. The heating of the atmospheric air secures also another very desirable effect and result, in that it causes a more complete union or combination of the carbon and oxygen, which have but little affinity for each other at ordinary temperatures, but a very strong affinity when they are raised to high temperatures. In order to so heat the atmospheric air supplied, the tube or vessel by which it is conveyed to the blower may, as is represented in the Drawing, enter into the direct flue and pass along through it, as is shewn by the dotted lines, and from thence into the blower, or it may be placed in any other position as to the flues and boiler so that the air will

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be heated. Such pipe may also be caused to pass through any heated place or apartment separate from the boiler, and with the same end secured. As before remarked, the position of such air tube or vessel is immaterial, provided it be so arranged that the air passing through it will be thoroughly heated, and that it connects with the blower, or the conductor F between the blower and the flue. When, therefore, desirable, the waste steam may be caused to pass through a series of tubes surrounded by the air, and in this manner the air may be heated, and without absorbing any of the heat of the furnace. By this method, also the steam will be condensed, and the water derived therefrom can be supplied again, and with a high temperature to the boilers; and generally any method most convenient under the circumstances of any particular case for heating the air may be made use of.

As will be apparent also from the foregoing description, the draft of the fire will depend upon or rather is produced and governed by the action and velocity of the blower referred to, and is not to any extent created or affected by the form or height of the chimney or smoke stack. An ordinary chimney is therefore all that is necessary to carry off the small amount of hot air, &c. which will pass off, and the expense of constructing tall and costly chimneys may, for the reason stated, be saved.

The practical operation of this Invention will be apparent from the following facts. The damper of the chimney is kept almost wholly closed, & but very little if any smoke is seen to rise from the chimney even when soft coal is burned, except for a minute or so, when the furnace doors are opened and fresh fuel thrown upon the fire. Previous to the application of the Invention to a furnace and boilers, the brick foundation supporting the boilers was only moderately heated, while the chimney for some distance up was hot, thus shewing the passage through it of a great amount of heat. And such is the situation and condition of furnaces and chimneys as ordinarily constructed. With the use however of this Invention the chimney is but slightly heated, while the foundation of the boilers becomes hot, proving that the heat is retained and made effective where it should be under the boilers. Careful & extended experiments has also shewn that by the application and use of this Invention to a furnace and boilers and engine full thirty per cent. of fuel is saved, and that while using the same kind of fuel and performing the same amount of work. By using an inferior kind of coal, that is, pea coal and coal dust, the saving is much greater.

To render the Invention self-adjusting or automatic, the speed of the, consequently the draft of the fire is regulated by and according to any required pressure of steam in the boiler. This may be effected by means of the

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following arrangement of mechanism, or any other securing the same end. From the boiler A a steam pipe J connects with or under a small cylinder K, placed where convenient, in which works loosely a float and piston L, which float rests upon a strong piece of vulcanized rubber, fastened between the bottom of the cylinder and the foundation K, on which it rests, and which 5 by its elasticity will allow of all necessary movement to the piston L. The lever M resting upon L is loaded to correspond to any required pressure of steam in the boiler. The long arm of such lever connects by means of the short bar O with the elbow or bent lever P, working on the pivot *p*, which lever is fastened to the strap stick frame *a, a*, which plays between the conical 10 pulleys Q, Q¹, carrying or moving by means of the links *c, c*, the band *b, b*. The conical pulleys are so placed that their largest and smallest diameters are opposite each other, one having a fast and loose pulley, over which plays a belt from the engine or any motive power, and the other pulley carrying a belt R, working the blower G. When the pressure of the steam in the 15 boiler exceeds the given standard, the lever L will be raised, and through its connections move the strap stick, and slide the belt *b, b*, to a smaller diameter of the conical pulley worked by the engine, and to a larger diameter of the other, and thus diminish the velocity of the blower and the draft of the fire. When the steam, on the other hand, falls below the given standard, a contrary 20 motion of the several parts will take place, and the belt be carried to a smaller diameter of the conical pulley Q¹, and increase the velocity of the blower and the draft of the fire. The practical operation of this arrangement is very perfect, & most highly satisfactory in its effect.

It is not claimed that it is new to bring the smoke and products of com- 25 bustion from the chimney and carry them under the furnace by means of a blower, and either with or without orifices in the blower case, for the admission of air at its ordinary temperature, neither is it generally claimed that the use of heated air to assist combustion is new, as this is found in the ordinary hot-blast furnaces; but what is claimed as new is, the arrangement 30 or combination of the pipe or vessel or conductor H, or its equivalent, substantially as set forth and described, with the blower G and flue or conductor F, conveying the smoke, &c. to the furnace, so as to furnish an abundant supply of air to the products of combustion, and to be mixed therewith by the blower before they are taken to the fire; and also placing such pipe or 35 vessel H, or its equivalent, in or connecting it with any heated apartment or locality, or heating apparatus, for the purpose of highly heating the air supplied by to the products of combustion and mingled therewith, as and for the purposes set forth. And also, in combination therewith, regulating the velocity

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of the blower, as described, or in any equivalent manner, by and according to the pressure of steam in the boiler, so as to increase or decrease the draft of the fire as necessary and automatically.

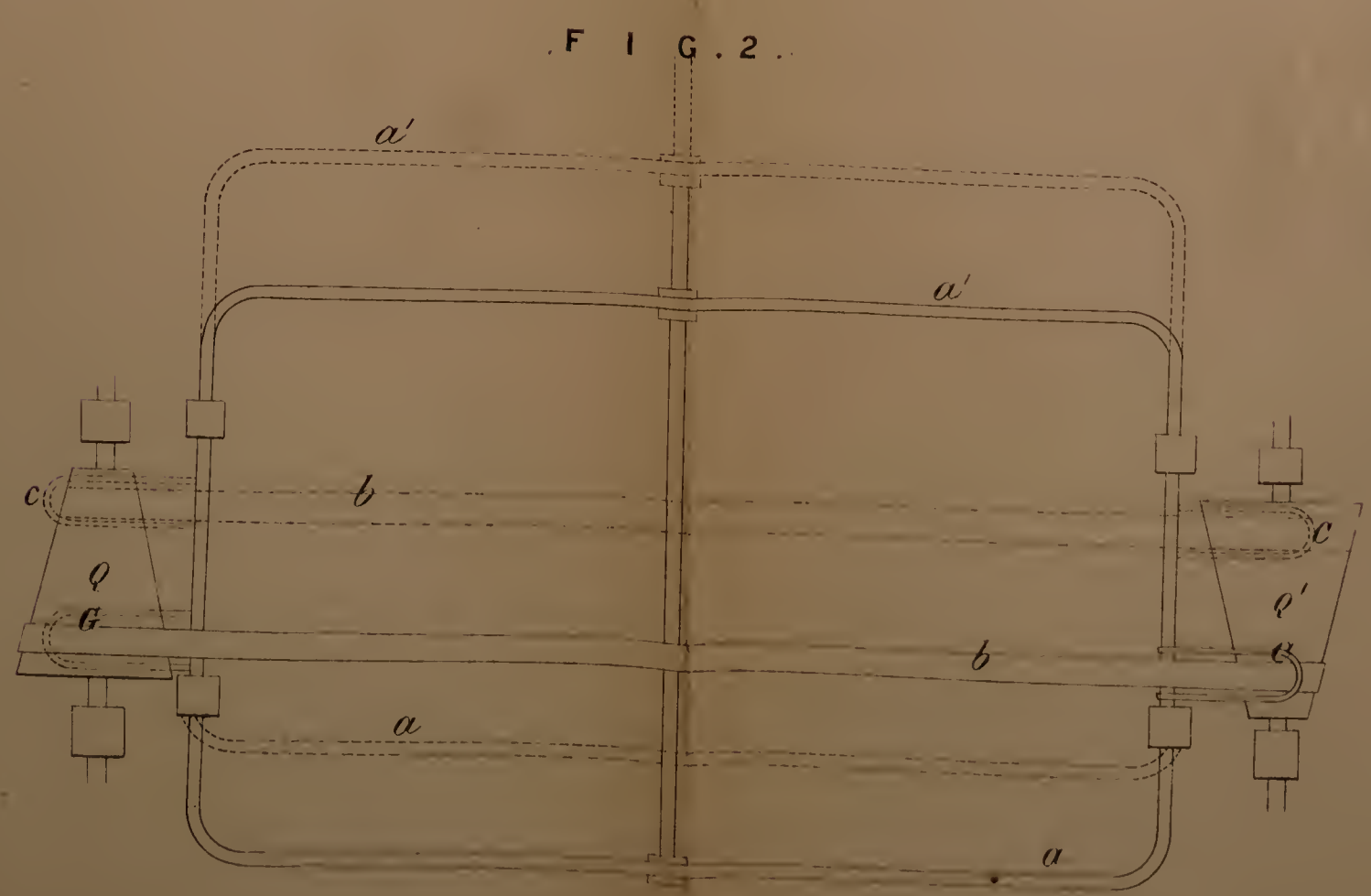
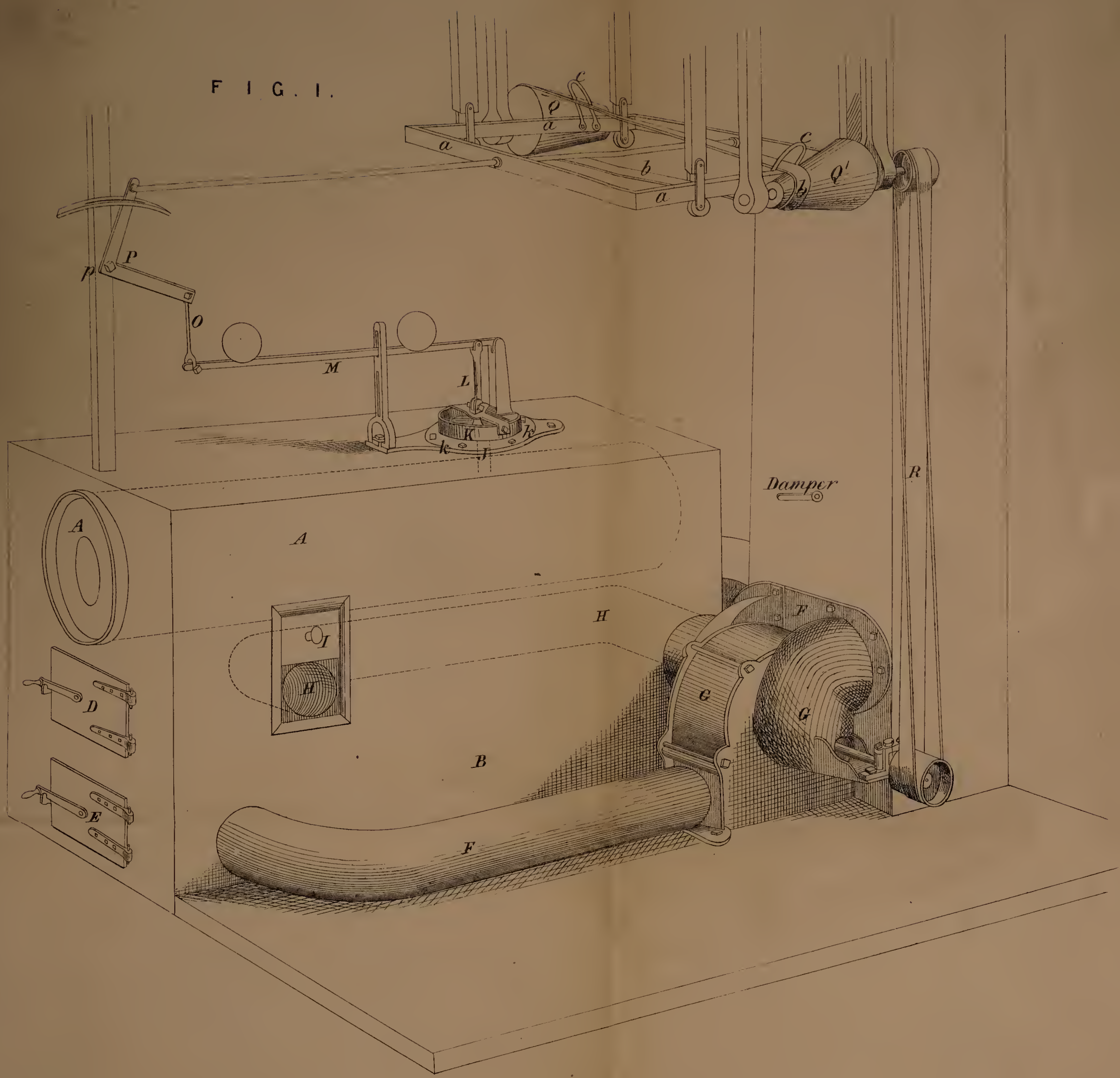
In witness whereof, I, the said Charles Barlow, have hereunto set my
5 hand and seal, the Tenth day of October 1857.

CHARLES BARLOW. (L.S.)

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